eNeurologicalSci 21 (2020) 100286

Contents lists available at ScienceDirect

eNeurologicalSci

journal homepage: www.elsevier.com/locate/ensci

Pattern and frequency of neurological and neurosurgical care of adult inpatients and outpatients at a tertiary referral hospital in Kenya

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ARTICLE INFO

Keywords:
Epidemiology
Hospital-based
Kenya
Low and middle-income country
Mortality
Neurological and neurosurgical disorders

ABSTRACT

Objective: To describe the patterns and burden of neurological and neurosurgical disorders at a national tertiary level referral hospital in western Kenya.
Methods: We conducted a three-month period prevalence study. We recruited consecutive adult patients seeking neurological-neurosurgical care in both inpatient and outpatient settings at Moi Teaching and Referral Hospital.
Results: 833 participants were included. The age range was between 19 year and 99 years (mean age = 45.3 years). The most common diagnoses among neurology inpatients were meningitis (12%), ischemic stroke (11.0%) and epilepsy/seizure (6.7%). Among neurology outpatients, epilepsy (35.1%) and ischemic stroke (18.8%) were the most common diagnoses. The most common neurosurgery inpatient diagnosis was hemorrhagic stroke (16.3%) and among outpatients, the most common diagnoses were traumatic brain injury (17.4%) and hemorrhagic stroke (16.3%). Overall, 471 (56.5%) patients underwent HIV testing, of which, 89 (18.9%) were HIV positive and 382 (81.1%) were HIV negative. Thirty-one inpatient deaths (male 58%), attributable to neurological and neurosurgical disorders, occurred during the study period. Meningitis was the most common cause of death.
Conclusions: The findings suggest that meningitis, stroke, epilepsy, and traumatic brain injury were the most common diagnosis. More resources and efforts should be directed towards prevention, diagnosis and management of these conditions in the region.

1. Introduction

According to the Global Burden of Diseases Report (2016), the burden of neurological and neurosurgical disorders has increased substantially over the past 25 years. These disorders are the leading cause of disease-adjusted life-years (DALYs) and the second leading cause of death globally [1,2]. Compared to high-income countries, the burden of neurological disorders is six times higher in low- and middle-income countries (LMICs), especially those in sub-Saharan Africa (SSA) and South Asia [2–4]. In Kenya, 37% of DALYs are attributable to non-communicable diseases (NCDs), of which 70% are due to neurological disorders [5]. Trauma and infectious diseases common in LMICs, such as HIV, malaria, tuberculosis, neurocysticercosis, onchocerciasis, and infestation by helminths, contribute to this burden of neurological disorders and are associated with morbidity and mortality. Despite their high burden in LMICs, neurological disorders are often stigmatized, ignored, under-recognized, and under-treated [6,7].

Hospital-based studies are important for two reasons: (1) to identify attributes associated with disease and the population that seeks care for their neurological symptoms; and (2) to improve care outcomes. In Kenya, for example, information about the hospital-based epidemiology of neurological and neurosurgical disorders is extremely limited. A

Abbreviations: DALY, disease-adjusted life-years; LMIC, low- and middle-income countries; MTRH, Moi Teaching and Referral Hospital; NCD, Non-communicable diseases; SSA, sub-Saharan Africa.

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https://doi.org/10.1016/j.ensci.2020.100286
Received 26 April 2020; Received in revised form 15 September 2020; Accepted 27 October 2020
Available online 2 November 2020

PubMed search revealed only one paper on a hospital-based study [8]. We address this lack of data by examining the nature of inpatient and outpatient neurological disorders seen at Moi Teaching and Referral Hospital (MTRH), a national referral hospital in western Kenya.

We conducted a three-month period prevalence study of consecutive patients to (1) evaluate the spectrum of inpatient and outpatient, adult neurological and neurosurgical disorders seen at MTRH, (2) describe demographics and outcomes in adult inpatients and outpatients, and (3) enumerate mortalities related to neurological and neurosurgical disorders at MTRH. In this paper, we present details about adult patients seeking care for their neurological and neurosurgical disorders at MTRH. This study adds to the available literature in explaining the nature of neurological and neurosurgical disorders seen in a tertiary-level hospital in an LMIC such as Kenya. Having a clear understanding of these disorders in this setting will provide a foundation for future research to improve neurological and neurosurgical care outcomes for the region.

2. Methods

2.1. Study design

We conducted a period prevalence study between March 1, 2019 to May 31, 2019, and identified consecutive neurology and neurosurgery patients seeking care at MTRH.

2.2. Setting

The study was conducted at MTRH in Eldoret, Kenya's second largest national referral and teaching hospital, located in the western part of the country. MTRH provides inpatient, outpatient, and specialized healthcare services in Eldoret. It offers an inpatient capacity of 960 beds and a wide array of outpatient specialty clinics serving a population of approximately 24 million people throughout western Kenya, parts of Eastern Uganda, Burundi, and Southern Sudan. MTRH provides care to more than 400,000 inpatients and outpatients annually and serves as the major teaching hospital for Moi University.

MTRH and Moi University have a long-term partnership with a group of North American institutions collectively known as the AMPATH (Academic Model Providing Access to Healthcare) Consortium who routinely send a visiting neurologist to support local personnel. Currently there are six neurosurgeons on staff with credentials at either MTRH or Moi University College of Health Sciences. Two Kenyan internal medicine physicians with neurology training attend to neurology consults in the wards and conduct weekly outpatient neurology clinics. Not all patients diagnosed with a neurological condition are seen by a visiting neurologist or physicians with neurology training. Often times, these patients are seen by medical officers or internal medicine physicians who consult with the neurologist on a case by case basis. The neurosurgical patients are typically seen by neurosurgeons.

MTRH has an MRI and two CT scanner machines, an EEG machine and a laboratory with capability to conduct CSF studies consisting of microscopy, biochemistry, culture and sensitivity, India Ink staining, CSF and serum CRAG and CSF GeneXpert tests. CSF viral panel tests are usually done locally through a private internationally certified laboratory.

2.3. Recruitment

This study was approved by the Institutional Review Board at Indiana University, USA and the Institutional Research and Ethics Committee at Moi University, Kenya. Data were collected by three research assistants (RAs) who received training in participant recruitment, explaining the study and answering questions regarding the study to patients and/or families, and REDCap (Research Electronic Data Capture) data entry. All had clinical backgrounds and were CITI (Collaborative Institutional Training Initiative) trained. Participants were not required to give written consent.

2.4. Participants

For inpatients, the inclusion criterion was adult patients admitted at MTRH with primary neurological and neurosurgical disorders. For outpatients, RAs contacted all adult patients attending the neurology clinic on their respective clinic days were approached in-person after the clinic. No patients declined to participate.

The procedure to identify inpatients included daily reviews of hospital admission records and daily inquiries in all the wards where patients with neurological and neurosurgical disorders were likely to be admitted. These patients were contacted within 24 h of admission.

Inpatient mortalities during the study period due to neurological and neurosurgical disorders were identified. RAs examined discharge data to determine the date of discharge or death. The Medical Records Department at MTRH confirmed information regarding mortalities.

2.5. Variables

The authors designed the survey instrument to reflect the neurological and neurosurgical diagnoses utilized at MTRH. Data collected included demographics, education level, type of residence, approximate distance to MTRH from home, date of admission, date of discharge, and neurological and neurosurgical diagnosis. Specific description about disease categories seen in both inpatients and outpatients include: 'Movement disorder' included Parkinsons disease, ataxia, essential tremors and dyskinesia. "Neurocognitive impairment" included dementia, "Somatoform disorder" included fibromyalgia where patients were functional. "Brain tumor/Neoplasm" included diagnoses such brain tumor, brain malignancy. The variable "Traumatic Brain Injury (TBI)" included epidural hematoma and subdural hematoma. Our purpose was to identify the broader classifications of neurological and neurosurgical disorders, and thus, we did not seek to identify the subclassifications of diseases and disorders. For example, we did not seek to identify specific types of epilepsy diagnoses/seizure classifications or the two types of hemorrhagic strokes.

2.6. Statistical analysis

The Wilcoxon rank sum test was used to test for differences between inpatient and outpatient continuous variables, and chi square or Fisher's exact test was used to compare distributions of percentages of categorical variables between inpatient and outpatient visits. The significance level was set at 0.05. Data were analyzed using SAS software version 9.4 of the SAS system for Windows copyright © 2002–2012 SAS Institute Inc. Cary, NC, USA.

3. Results

We enrolled 833 adult patients seeking care at MTRH for neurological and neurosurgical disorders between March 1, 2019 and May 31, 2019. We collected data from 625 inpatients and 208 outpatients. During the study period, a total of 9356 adult inpatients and 94,596 adult outpatients were seen in the hospital, suggesting neurology/neurosurgery inpatients constitute 6.7% of all inpatients, and 0.22% of all outpatients at MTRH.

3.1. Demographics

The demographic characteristics of the neurological and neurosurgical patients are described in Table 1. Two hundred and eighteen (26.2%) patients were older than 60 years of age. Five hundred and eight (61.0%) patients were male, and 325 (39.0%) patients were female, resulting in a sex ratio (M/F) of 1.56/1. A majority of adult patients had

Table 1
Demographic details of inpatients and outpatients.

Variables		Inpatient 625 (75%)	Outpatient 208 (25%)	*P*-value*
Age	Median(IQR)	40.0 (29.0, 59.0)	47.5 (26.0, 65.0)	0.41
Gender	Male	415 (66.4)	93 (44.7)	<0.0001
	Female	210 (33.6)	115 (55.3)	
Educational Status	No Formal Education	91 (14.6)	8 (3.9)	<0.0001
	Primary education	254 (40.8)	85 (41.7)	
	Secondary education	216 (34.7)	93 (45.6)	
	Diploma/ degree	62 (10.0)	17 (8.3)	
	Masters and above	0	1(0.5)	
~ Distance from home to MTRH (Kilometers)	Median(IQR)	70.0 (34.4144.2)	45.0 (20.0, 80.0)	<0.0001
Residence	Rural	482 (77.1)	146 (70.2)	0.04
	Periurban	143 (22.9)	62 (29.8)	

* *P* values reflect total comparison between inpatient and outpatient variables and not individual variables.

either primary education or secondary education. Adult patients were predominantly from rural areas ($p = 0.04$) and traveled a mean distance of 86.4 km to MTRH, with adult inpatients traveling farther than adult outpatients (inpatient mean (SD) = 93.8 (85.4) kilometers vs outpatient mean (SD) = 64.1 (60.3) kilometers, $p \leq 0.0001$).

3.2. Diagnoses

3.2.1. Neurological diagnoses

Fig. 1 shows the most frequent neurological diseases in both adult inpatient and outpatient settings. Most inpatient admissions during the three-month study period were due to meningitis (11.8%), Ischemic stroke (11%) and seizure/epilepsy (6.7%), and the most common outpatient diagnoses were seizure/epilepsy(35.1%), Ischemic stroke (18.8%) and movement disorder (6.7%). Among inpatients with epilepsy, two patients were admitted due to severe burns related to seizures.

Table 2 displays the ages and length of stay for each major adult neurological diagnosis. Inpatients with epilepsy (median age = 38 years) were significantly older than their outpatient counterparts (median age = 25 years, $P = 0.002$). Outpatients with headache (median age = 51 years) were older than their inpatient counterparts (median age = 39 years, $p = 0.02$). The average length of stay for adult neurology inpatients was 8.6 days (SD = 3.9).

3.2.2. Neurosurgical diagnoses

Fig. 2 details the most frequent neurosurgical diseases in both inpatient and outpatient setting. The most common neurosurgical inpatient diagnosis was traumatic brain injury (TBI) (17.4%), followed by hemorrhagic stroke (23.2%), which was also the most common outpatient diagnosis. While the traumatic lesions found with TBI were not documented for the purposes of this study, of those identified, 55.4% were reported to have a co-existent subdural hematoma.

Table 3 describes the age and length of stay of neurosurgery patients. Outpatients with hemorrhagic stroke (median age = 66 years) were significantly older than their inpatient counterparts (median age = 53.6 years, $p = 0.018$). The average length of stay of inpatient neurosurgery patients was 9 days (SD = 3.6).

3.2.3. HIV status

Table 4 and Table 5 describes the HIV status of inpatients and outpatients with neurology and neurosurgical diagnoses respectively. Overall, 471 (56.5%) patients underwent HIV testing, of which, 89 (18.9%) were HIV^+ and 382 (81.1%) were HIV^-. Two hundred and two (24.2%) patients were untested. Among all inpatients, 331 (53%) underwent HIV testing, of which, 81 (24.4%) were HIV^+ and 250 (75.5%) were HIV^-. Among all outpatients, 140 (67.3%) patients underwent HIV testing, of which, eight (5.7%) were HIV+ and 132 (93.8%) were HIV^-. Fifty-two (25%) patients were untested.

3.3. Mortality

Thirty-one inpatient deaths due to neurological diseases were reported during the study period. Table 6 outlines the age, gender, and the disease-specific mortality related to neurological diseases. There was no significance difference between male and female deaths ($p = 0.55$) Meningitis was the most common cause of death.

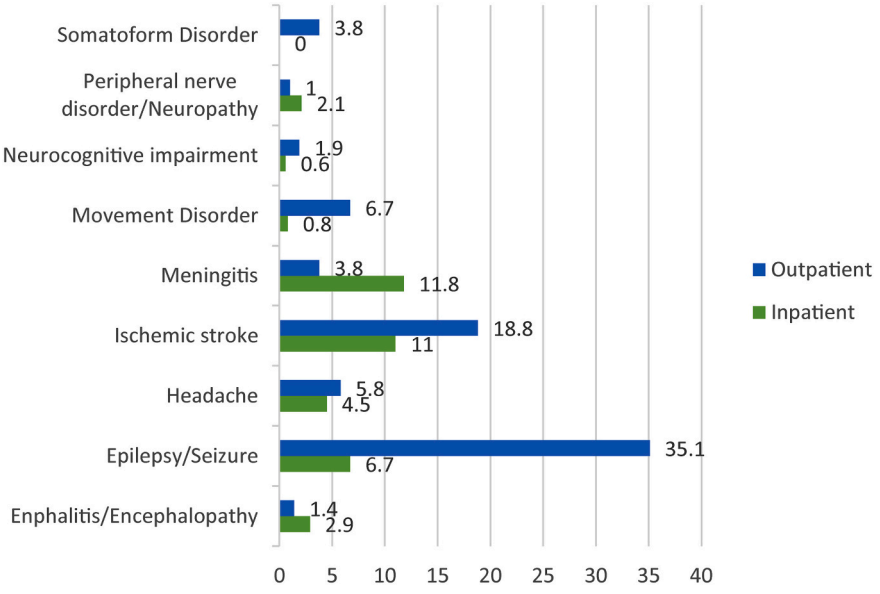

Fig. 1. Major adult neurology diagnosis.

Table 2
Age and Length of stay of patients with major neurological diagnoses.

Disease condition		Age			Inpatient length of stay
		Inpatient	Outpatient	*P*-value	
Epilepsy/Seizure disorder	**N**	**42**	**73**		
	Median (IQR)	38.0 (28.0, 63.0)	25.0 (20.0, 39.0)	0.002	7.0 (3.0, 14.0)
Encephalitis/Encephalopathy	**N**	**18**	**3**		
	Median (IQR)	41.5 (34.0, 53.0)	66.0 (51.0, 79.0)	0.34	8.5 (2.0, 24.0)
Headache	**N**	**28**	**12**		
	Median (IQR)	39.0 (27.5, 58.0)	51.0 (46.0, 67.0)	0.02	4.0 (2.0, 16.0)
Ischemic Stroke	**N**	**69**	**39**		
	Median (IQR)	67.0 (51.0, 78.0)	62.0 (42.0, 69.0)	0.10	10.0 (6.0, 20.0)
Meningitis	**N**	**74**	**8**		
	Median (IQR)	39.0 (31.0, 49.0)	27.0 (21.5, 48.0)	0.16	14.0 (7.0, 20.0)
Movement Disorder	**N**	**5**	**14**		
	Median (IQR)	65.0 (60.0, 72.0)	65.0 (49.0, 67.0)	0.74	4.0 (4.0, 5.0)
Neurocognitive Impairment	**N**	**4**	**4**		
	Median (IQR)	79.0 (72.5, 87.5)	55.5 (46.5, 67.5)	0.04	12.5 (7.5, 21.5)
Somatoform disorder	**N**	–	**8**		
	Median (IQR)		57.0 (29.0, 62.5)		

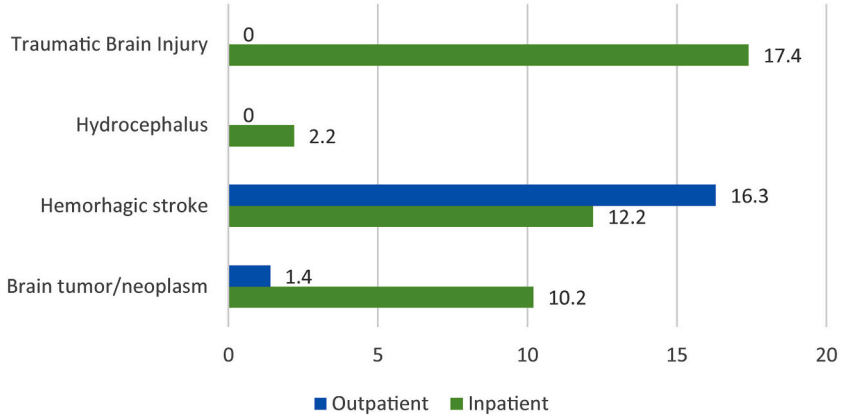

Fig. 2. Major adult neurosurgical diagnoses.

Table 3
Age and length of stay of patients with major neurosurgical diagnoses.

Disease condition		Age			Inpatient length of stay
		Inpatient	Outpatient	*P*-value	
TBI	**N**	**109**			
	Median (IQR)	32.0 (25.0, 39.0)			5.0 (3.0, 9.0)
Hemorrhagic stroke	**N**	**76**	**34**		
	Median (IQR)	57.5 (33.5, 70.5)	66.5 (62.0, 73.0)	0.018	7.0 (4.0, 14.0)
Brain tumor/ neoplasm	**N**	**64**	**3**		
	Median (IQR)	45.5 (35.0, 58.0)	43.0 (43.0, 74.0)	0.68	12.5 (6.5, 22.0)
Hydrocephalus	**N**	**14**	–		
	Median (IQR)	28.5 (23.0, 40.0)			11.5 (4.0, 35.0)

4. Discussion

Our study yielded several important findings. First, there were demographic differences in healthcare utilization based on educational status, gender, residence, and distance to MTRH. Second, the most common diagnoses among adult patients were TBI, epilepsy, meningitis and stroke. Our hospital-based study added to the limited research on patients seeking care for their neurological and neurosurgical disorders in LMICs such as Kenya. We found that the overall age and education of adults were evenly distributed, with the majority of the individuals having primary or secondary education. Based on our findings, patients who had higher education were more likely to visit the MTRH outpatient clinic for neurological and neurosurgical care. This finding suggests that people with higher education are likely to receive more advanced or preventative care for acute exacerbations of their disorders. Our findings also suggest that inpatient adults traveled a longer distance, with a majority of them coming from rural areas, where there are fewer medical resources available. Additional studies that explore the contributions of socioeconomic status and cultural factors to care-seeking patterns of patients with neurological diseases are needed to help explain these differences.

TBI continues to be a major public health problem in Kenya, and reports suggest that the prevalence is increasing [9]. As the second largest health facility in the country, MTRH receives most of the trauma cases in the city and neighboring areas. The diagnosis mainly confers traumatic intracerebral hemorrhage, brain contusions, and concussions. Our findings on TBI are consistent with hospital-based studies conducted in Uganda [10,11] and Tanzania [12].

The global burden of epilepsy is well described. The disease is the most common neurological disorder, particularly in SSA [13]. Seizures and their consequences contribute to the burden of the disease and globally continue to cause disability and mortality [14]. Based on a meta-analysis, the estimated lifetime prevalence of epilepsy in SSA was

Table 4
HIV status for major neurology diagnoses.

	Inpatient			Outpatient		
	Positive	Negative	Not checked	Positive	Negative	Not checked
Epilepsy/Seizure	6 (14.3%)	27 (64.3%)	9 (21.4%)	3 (4.1%)	49 (67.1%)	21 (28.8%)
Encephalitis/Encephalopathy	9 (50.0%)	7 (38.9%)	2 (11.1%)	0	2 (66.7%)	1 (33.3%)
Headache	1 (3.6%)	11 (39.3%)	16 (57.1%)	0	7 (63.6%)	4 (36.4%)
Ischemic Stroke	4 (5.3%)	53 (69.7%)	19 (25.0%)	0	25 (73.5%)	9 (26.5%)
Meningitis	52 (70.3%)	20 (27.0%)	2 (2.7%)	5 (62.5%)	3 (37.5%)	0
Movement Disorder	0	2 (40.0%)	3 (60.0%)	0	10 (71.4%)	4 (28.6%)
Neurocognitive Impairment	0	2 (50.0%)	2 (50.0%)	0	2 (50.0%)	2 (50.0%)
Somatoform disorder	–	–	–	0	7 (87.5%)	1 (12.5%)

Table 5
HIV status for major neurosurgical diagnoses.

Disease condition	Inpatient			Outpatient		
	Positive	Negative	Not checked	Positive	Negative	Not checked
Brain Tumor/Neoplasm	4 (6.3%)	29 (45.3%)	2 (66.7%)	0	2 (66.7%)	1 (33.3%)
Hemorhaggic stroke	4 (5.3%)	53 (69.7%)	19 (25.0%)	0	25 (73.5%)	9 (26.5%)
Hydrocephalus		10 (71.4%)	4 (28.6%)	–	–	–
Traumatic Brain Injury	1 (0.9%)	36 (33.0%)	72 (66.1%)	–	–	–

Table 6
Mortalities due to neurological diseases.

		Adult n = 36
Age	Median (Min, Max)	31 (19, 94)
Gender	Male	21 (58.5%)
	Female	15 (41.6%)
Meningitis		12 (33.3%)
Stroke		4 (11.1%)
Encephalopathy		3 (8.3%)
Neoplasm/brain tumor		1 (2.7%)
Epilepsy		1 (2.7%)
Neuropathy		1 (2.7%)
Unspecified		1 (2.7%)

reported to be 16 per 1000 people [15]. In western Kenya, the crude lifetime prevalence of epilepsy was reported to be 25 per 1000 people [16]. The only other hospital-based study from Kenya reported that epilepsy (16.6%) was the second most common neurological disease at Kenyatta National Hospital (KNH) in Nairobi [8]. Other hospital-based studies from SSA, including Zambia [17,18] and Tanzania [19], also reported epilepsy as a common diagnosis. Our study found epilepsy as the most common diagnosis among outpatients, though our data did not distinguish between types of epilepsy. The patients admitted with consequence related to seizures, and one death, which was due to status epilepticus, suggest that epilepsy is an important and prevalent public health concern in the region.

A 26-country region of SSA including Kenya has been afflicted for over a century with meningitis epidemics, especially during the January-to-June months [20]. Although we do not have specific details about the causative organism for the disease, the high inpatient rates of meningitis might be that we collected data between March and May. HIV associated meningitis is the leading cause of adult meningitis in sub-Saharan Africa, and associated with high mortality rates [21]. Majority of the meningitis patients seeking care at MTRH were HIV+, and most of the deaths attributable to neurological disease were among patients with meningitis. Meningitis has been associated with high mortality, especially when diagnosis or treatment is delayed [22]. Treatment for HIV associated meningitis is challenging even in high-income countries [21].

Although stroke mortality and DALY have declined worldwide, the global burden of the disease is likely to remain high [23]. Recent trends suggest that SSA now bears the highest burden of stroke worldwide [24]. Globally, the risk of ischemic stroke is 18.3% compared to an 8.2% risk of hemorrhagic stroke [25,26]. A prospective study conducted at KNH and MTRH between February 2015 and January 2016 also found that ischemic stroke accounted for 56.1% of the stroke cases [27]. Consistent with these findings, we also found a higher rate of ischemic strokes compared to hemorrhagic strokes. This finding is important because ischemic strokes can often be prevented through lifestyle changes and risk factor modification therapies.

The findings of our study were consistent with the only hospital-based study conducted in Kenya previously [8]. Similar to the previous study, our study also found that meningitis, epilepsy and cerebrovascular diseases were the commonest neurological diseases at MTRH. This is suggestive that the burden of these diseases continue to be a public health concern in Kenya.

Our study had limitations. The study was conducted over a period of three months, and the cohort is likely to represent certain seasonal diseases, which may not be as prevalent during different times of the year. Our data does not represent findings from the neurosurgical outpatient clinic at MTRH. Finally, Like in many other SSA countries, there is a paucity of neurologists at MTRH, thus, neurologists or physicians who have neurology training may not have confirmed some of the diagnoses.

5. Conclusions

During the study period, the three common neurological and neurosurgical conditions among adults were traumatic brain injuries, epilepsy, and stroke. Inpatients traveled farther to the hospital compared to the outpatients, and men were less likely to come for outpatient follow up compared to women. Diagnostic and therapeutic efforts should be directed to managing the most common neurologic conditions in this region.

Funding

This work was supported in part by the EMPOWER, Indiana University Office for Women and Office of the Vice President for Research.

CRediT authorship contribution statement

Jane R. von Gaudecker: Conceptualization, Funding acquisition, Methodology, Data curation, Supervision, Writing - original draft. **Chrispine Oduor:** Conceptualization, Methodology, Data curation,

Supervision, Writing - review & editing. **Susan Ofner:** Formal analysis, Writing - review & editing. **Eren Oyungu:** Conceptualization, Writing - review & editing. **Jamil Said:** Conceptualization, Writing - review & editing. **Janice Buelow:** Conceptualization, Writing - review & editing.

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